

REMARKS

Claims 1, 3, 5-7, 10, 12-20 and 51-54 are pending in the application and stand rejected. Claims 1, 3, 5-7, 10, 12-18 have been amended. New claims 51-54 have been added herein. No new matter is added. In light of the foregoing amendments and the following remarks, Applicants earnestly solicit favorable reconsideration.

On the Merits

Claim Rejections - 35 U.S.C. § 102(b)

Claims 1-20 were rejected under 35 U.S.C. §102(b) as being anticipated by EP 1 085 586, hereinafter, '586.

Some feature of the claimed spin injection device of the are that

(1) the magnetization of ferromagnetic free layer is reversed by the low current such as 1 mA or less,

(2) magnetization of reversal of ferromagnetic free layer can be performed without external magnetic field.

Regarding the '586 reference:

Please note that in a ferromagnetic double tunnel junction element used for MRAM cited in FIG. 10 of '586, the magnetization reversal of the ferromagnetic free layer can be performed

with applying external magnetic field. In MRAM, an external magnetic field is applied to a ferromagnetic double tunnel junction element 10 by the word line for writing (WL2) (see '586, paragraph [0048] to [0050] and Fig.9.). Please also note that "MRAM needs to supply the spin current and the current magnetic field to the magnetic recording layer" (see '586, paragraph [0059] lines 14-15.). The spin current means the current flowing in a ferromagnetic double tunnel junction element. The current magnetic field means the magnetic field generated by the word line for writing (WL2).

Applicants respectfully submit that the examiner misunderstands that a ferromagnetic double tunnel junction element of FIG. 36 in '586 will operate as the same as MRAM.

Regarding claims 1, 3, and 5 and the '586 reference:

Some features of the spin injection device of claim 1 are that

(1) spin injection device has one tunnel junction. A ferromagnetic double tunnel junction element of '586 has double (two) tunnel junction.

(2) the magnetization of ferromagnetic free layer is reversed by the low current such as 1mA or less,

(3) the magnetization of reversal of ferromagnetic free layer can be performed without external magnetic field.

As to the aspect ratio of claims, the characteristics in FIG. 36 of the '586 reference corresponds to the device as shown in FIG.1. The device structure of FIG. 1 is a magnetoresistive element which has a double tunnel junction having ferromagnetic free layer consisting of a Co-based alloy or three layered film of a Co-based alloy/ a Ni-Fe alloy/a Co-based alloy (see '586, paragraph [0026]).

As may be known by the examiner, Co-based alloy and Ni-Fe alloy (sometimes called as permalloy) are ferromagnetic materials. So, the ferromagnetic free layer of Fig. 1 in '586 has no SyAF structure (see '586, paragraph [0187]).

The behavior of a ferromagnetic free layer made of SyAF layer about an aspect ratio is very different from that of the conventional ferromagnetic free layer as shown in the device in FIG. 1 of the '586 reference. Please see an explanation of this feature in the present specification, for example in paragraphs [00401 to [0044].

The drawbacks of the ferromagnetic free layer made of usual ferromagnetic material is described in paragraph [0005] of the present application.

Please note that with the reducing of the junction width (W), a reversal of the magnetic field increases (see '586, paragraph [0187]), i.e. these are some drawbacks of the ferromagnetic free layer made out of the usual ferromagnetic material.

The '586 reference neither discloses nor implies that the aspect ratio of SyAF layer is less than 2, (as recited in claims 6, 13 and 54).

Regarding claims 7, 10, 12, 13, 14 and the '586 reference:

Some features of the spin injection device of claim 7 (e.g. FIG.8) are that:

(1) the magnetization of ferromagnetic free layer is reversed by the low current such as 1mA or less,

(2) the magnetization of reversal of ferromagnetic free layer can be performed without external magnetic field.

As to the aspect ratio of claim 13, please argue as same as explained in claim 6.

Regarding claims 15 and 16 and the '586 reference:

Some of the features of the spin injection device of claim 15 (FIG. 4) are that:

(1) The spin injection device has ferromagnetic layer 26/ nonmagnetic (insulating) layer 7/ ferromagnetic free layer 27 / Ru layer 28 and has no SyAF structure.

(2) the magnetization of ferromagnetic free layer is reversed by the low current such as 1mA or less,

(3) the magnetization of reversal of ferromagnetic free layer can be unformed without external magnetic field.

'586 neither discloses nor implies that the device structure and the effect of claim 15 and 16.

Regarding claims 17 and 18 and the '586 reference:

Some of the features of the spin injection device of claim 17 (FIG.6) are that

(1) the spin injection device has a device structure consisting of ferromagnetic layer 26/
nonmagnetic (insulating) layer 7/ ferromagnetic free layer 27/ Ru layer 28 / ferromagnetic fixed
layer 29.

(2) the magnetization of ferromagnetic free layer is reversed by the low current such as
1mA or less,

3) the magnetization of reversal of ferromagnetic free layer can be performed without
external magnetic field.

The '586 reference neither discloses nor implies that the device structure and the effect of
claim 17 and 18.

Regarding the newly added claims 21 to 24 and the '586 reference:

The features of the spin injection device of claim 21 have the same structure of claim 1
except that injection junction part consists of a nonmagnetic conductive layer 7 in place of
nonmagnetic insulating layer 12.

The features of the spin injection device of claim 17 (e.g. FIG. 6) are the same as claim 1.

The '586 reference neither discloses nor implies that the device structure and the effect of claim 20 to 24.

In view of the above, Applicants respectfully submit that their claimed invention is allowable and ask that the rejection under 35 U.S.C. §102 be reconsidered and withdrawn. Applicants respectfully submit that this case is in condition for allowance and allowance is respectfully solicited.

If any points remain at issue which the Examiner feels may be best resolved through a personal or telephone interview, the Examiner is kindly requested to contact the undersigned at the local exchange number listed below.

If this paper is not timely filed, Applicants respectfully petition for an appropriate extension of time. The fees for such an extension or any other fees that may be due with respect to this paper may be charged to Deposit Account No. 50-2866.

Respectfully submitted,
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